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THE ELECTROTYPE.

In accordance with the prevailing spirit, for magnificent and comprehensive names, we are furnished with the above mentioned title for a process, which has been very generally noticed in its application to copying medals, copper plates, etc. We have at different times furnished our readers with notices of this discovery, and details as to the mode of operation, (see vol. IX, p. 230, vol. X, p. 50, and 299.) It has now become a matter of much interest, and bids fair to rank among the useful arts; we therefore propose to give a general idea of the principle and its applications, refering to the articles above named, for the history of its progress.

It is well known, that in all galvanic circles there must be a complete communication either by metal or conducting solutions.

The simplest instance of a galvanic circle is to be found in the well known experiment of placing a slip of copper on one side of the tongue and one of zinc on the other. No peculiarity of taste is to be remarked but on bringing the ends of the strips into contact a very peculiar taste is instantly observed. Here the mositure on the tongue is the exciting liquid which in this, and in every other case must be a conductor, and capable of being decomposed.

Again, in dilute sulphuric acid, a piece of pure zinc and another of copper may lie near each other without producing any apparent effect, but on causing the pieces to touch, either directly or through the intervention of a wire, the decomposition of the water will proceed so rapidly as to cause the mixed grains in their escape to throw the liqnid into a foam.

If a strip of zinc, and one of copper, soldered together be immersed in a solution of sulphate of copper, the solution will be decomposed, but the mixture of the products of decomposition disguises the results. If the vessel containing the solution be divided by a partition of muslin or paper, we can place on one side a solution of sulphate of copper, and on the other

either acidulated water or a solution of Glauber salt—without any danger of mixing although they are actually in contact. If the copper plate is now immersed in the solution of copper and the zinc plate in the other solution, metallic connection being established by a copper soldered to both plates, it will be found that the zinc gradually dissolves and the copper plate is covered by a deposition of pure metallic copper—while the solution in which it is immersed gradually loses its blue color. The copper deposited is in the form of crystals, but presenting a continuous surface, provided that the plate has the same; any variation in the surface of the plate will be precisely copied in the deposite, and hence the process resolves itself into what we might denominate a *cold casting of copper.*

The simplest form of this experiment, which can be tried almost for nothing, and which will amply repay the little trouble it costs, is as follows. Take a vial without a bottom, or still better, the bottom of a glass lamp chimney (the whole can be used without injuring it,) tie over the smoothest end a piece of paper very closely, place this with the covered end down, in a larger vessel. Place in the outer vessel a strong or saturated solution of sulphate of copper (blue vitriol) and in the inner vessel, water to the same level, into which a little glauber salt, sal ammoniac, or common salt must be thrown. Let a strip of clean copper be placed in the outer solution and a strip of zinc in the inner one with their ends projecting above the glass, and united by a copper wire bound tightly around, or soldered to each. If the apparatus is now placed in any convenient position for observation and where the liquid will not evaporate too rapidly, it will be found that the zinc dissolves, the blue color of the copper solution gradually disappears and brilliant crystals of copper cover the entire surface of the copper strip. At the conclusion of the experiment, which will be in one, two or more days, according to the quantity of sulp. of copper employed, the plates may be taken out, and by using a little force the copper coating may be nearly all removed, when it will be found to have faithfully copied all the minute scratches and irregularities of the surface of the plate.

A stil more simple modification of this experiment, when small quantities only are used, consists in employing the bowl of a common tobacco pipe with the hole at the bottom stopped with a bit of wax, this furnishes the inner vessel which is porous over its whole surface. It may be placed in a wine glass or any other convenient vessel, and the solutions and metals arranged before, we may however dispense with a copper plate by immersing a coil or even simply one end of the copper wire used to form the union with the zinc. With the bowl of a common tobacco pipe (with the hole closed,) a wine glass, a piece of blue vitriol as large as a pigeon's egg, a piece of sheet zinc as large as can cover the little finger and five or six inches of copper wire or a narrow strip of sheet lead—this interesting experiment can be prepared in a few minutes, and will afford the most complete satisfaction.

In the useful application of this experiment, it has been found advisable

to use plaster of Paris as a porous diaphragm instead of paper, but the principle and general arrangement remain unaltered. For a minute detail of the best mode of preparing the apparatus for coppying medals, etc., we refer our readers to the very excellent and yet plain directions of Mr. Spencer, the inventor, vol. X, p. 300.

In coppying medals, the inventor purposes to place the medal between two pieces of sheet lead and subject the whole to a powerful pressure. In this manner a complete matrix is obtained, giving the minutest lines on the surface of the copper. One of these leaden matrices is next to be soldered to a copper wire as above, and placed in the copper solution, the zinc remaining the same as before. The copper is then gradually deposited upon the lead, and the fac simile of the medal thus formed.

It is obvious that a matrix of coper may be made at once from the medal and this copied again by the same process. In this case, however, there is a risk of the adhesion of the copper, unless means are taken to prevent it. The different expansibilities of lead and copper allow of their easy removal when in the most exact contact.

By these same methods copper plates may be coppied to an indefinite extent without losing any of the lines of the original. The London Journal of April last, contains two impressions side by side one from an etching after Rembrandt, the other from the copied plate obtained by the method last mentioned, which includes two electrotype transfers of the design, and yet there is no difference, save in the printing, that can be detected by a magnifier.

Yet another method is that of Jacobi, he uses fusible metal to obtain the matrix and deposites the copper upon this. We have examined a medallion head of Thorwaldsen copied in this manner by Dr. Jacobi himself, and which presents the utmost shapeness and clearness which can be imagined. We have also examined a head of Franklin, copied by Franklin Peale, Esq. of Philadelphia, in which notwithstanding its great size there could not be found a blemish.

Having thus reviewed what has been done, let us proceed to a consideration of what may still further be accomplished.

The stereotyping in copper any wood cut designs is perfectly analogous to the process for copying medals, etc. It is also very possible that designs may be executed at once in copper with great facility and without costing as much as wood cuts, and possessing in common with them the advantage of not requiring a separate press but admitting of being worked in with letter press. The process would be somewhat such as this. Prepare a perfectly smooth plate of lead, cover it to a uniform thickness with wax, upon this write or draw the design directly, and without reversing—cut the design thus traced down to the lead--immerse the plate for a short time in dilute nitric acid and then place it in the solution forming contact as before. The copper is deposited at once in the form intended to be used. A drawing of the apparatus used in the electrotype, has been engraved by the in

ventor in this manner and resembles a wood cut. We have thus a means by which a tolerable draughtsman may at a very trifling expense furnish cuts of the most elaborate designs, ready for the printers' use.

It is true that this branch of the invention has not yet attained the perfection which its earlier applications have reached, but it is to be remembered that while the one attempts to furnish a new mode of publishing original designs, the other aims only at copying those already executed.

It is this application of the art which we think promises the most useful and widely extended results.

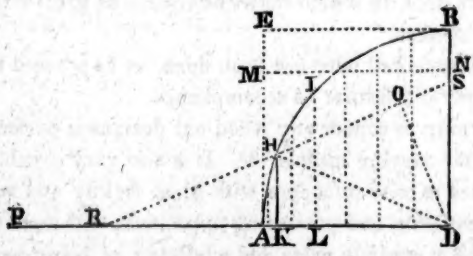
There is, however, another use to which the electrotype can be put which we have not seen even hinted at; it is this—we can with a very little contrivance, execute such parts of delicate machinery and apparatus as can be made of copper—by means of a model, without the use of any cutting instrument or other tools for working in metal. When it is recollected that copper precipitated in this manner is harder than when cast, it is easy to conceive of many cases in which it may replace brass.

The whole subject, however, is full of interest, and we might weary out our readers with a list of suggested applications, which, however, we leave each one to form for himself. We feel strongly inclined to suspect that in general practicability and usefulness, this art will excel its more famous rival the Daguerreotype.

If one use alone can be made of it, viz. to afford a cheap and expeditious means of executing diagrams, maps and other professional designs we shall be satisfied, and we hope that it will afford us the means of frequently gratifying our readers with cuts from which we are obliged to abstain on account of the high price of wood engraving.

THEORY OF THE CRANK.

FIG. 1.

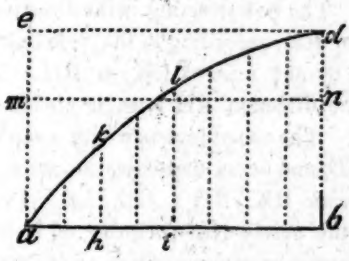


Let D, Fig. 1 represent the centre of motion, and AIB one fourth of the circumference of the circle, described by the crank. Suppose, also, the moving power to act in a direction *parallel* with the line PD, and with the same intensity at all points. The effect of the power at any point, in causing the crank to revolve is in proportion to the distance of the line of its direction from the centre of motion. Thus, in passing from A to B, the effect increases in the proportion of the ordinates HK, IL, etc. From B

through the next quadrant the effect is diminished in the same proportion. In passing the third quadrant it is again increased, and in the fourth quadrant diminished in a similar manner.

The several ordinates HK, IL, BD, etc., may be considered as representing the different levers with which the power acts, and as the sum of all the ordinates inscribed in the quadrant ABD is equal to the area of the quadrant, by dividing that area by AD, the quotient exhibits the mean or average length of the several levers, equal to the height DN of a rectangle AN, whose area is equal to that of the quadrant. If AD=1, DN, will be found by calculation to be equal to ·7854. Although DN, is the mean length of the several levers with which the power acts, it must not in estimating the effect of the power be taken as representing the *mean leverage.*

Fig. 2.



It may with propriety be assumed that the motion of the crank is uniform, since in a train of railway cars under motion, the momentum of the moving mass is so great as to counteract the tendencies to irregularity. Hence the crank in moving from A to B, has an uniform motion, passing over equal portions of the arc in equal times. Make the line *ab*, in Fig. 2, equal in length to the arc AB, in Fig. 1, and suppose ordinates to be erected from the several points between *a* and *b*, equal in length to those drawn from corresponding points in the quadrant. That is, *ah*, and *ai* being equal respectively to AH and AI, make *hk*=HK and *il*=IL, also *db* =DB, etc. From *a* through the points *k*, *l*, etc., draw the curve line *a*, *k l*, *d*. As the crank in passing with an uniform motion from A to B, or its equal *ab*, acts with the different levers represented by the ordinates drawn to the several points, it follows that the area of the figure *aldb* represents correctly the sum of all the different levers upon each of which the power operates an equal length of time; and hence, dividing by *ab* gives the height *bn* of a rectangle equal to that area; consequently *bn* is the *true mean leverage* of the crank for the quadrant AB, and for the reason above assigned is also the mean leverage for each of the other quadrants.

It will be found by calculation, that if *ab* be taken equal to unity, that *bn* is equal ·636+. Consequently the power acts with a force or produces an effect equivalent to that which it would produce if operating constantly at right angles to, and at the extremity of, a crank whose length is .636+.

It will be found that this decimal is the same with that of the ratio of the circumference of a circle, to twice its diameter, and as these quantities are the measures respectively of the velocities of the extremity of the crank, where the power is applied, and of the motive power, it follows that the *principle of virtual velocities* is true in its application to the movement of the crank under the circumstances as assumed.

Where the power operates through the medium of connecting rods as in locomotive engines, the effect of the arrangement is to increase the leverage at certain points, and diminish it at others. The least length which a connecting rod may have is that of the length or *throw* of the crank; that is, it can never be less than AD, or BD.

Assuming the rod to be of this length, the leverage with which the power acts, is easily ascertained—suppose in Fig. 1, RH, to be the position of the rod. Produce RH, to S, and from D, perpendicular thereto draw DO—draw also HD. The power acting in the direction PD, produces an effect in the direction of RH, according to the principles of the resolution of forces, represented by the ratio of RK to RH. The leverage with which the force in the direction RH acts, is obviously correctly represented by the line DO. The actual leverage with which the moving power acts is greater than OD, and bears therefore, the same relation to OD, as RH to RK. By geom. RK : RH : : OD : DS. DS, is therefore the leverage with which the power acts when the rod is in the position RH, and in general, *the leverage for any position of the rod, while the crank is passing from A to B, is correctly represented by the distance from D to the point where the line of the rod produced, intersects the perpendicular raised from D.*

Again, as RH is assumed equal to HD, the line RK is equal to RD, and by geom. DS is equal to twice HK. But HK is shown above to be the leverage, when the power acts upon the crank parallel to PD. Hence, in describing the quadrant AB, the actual leverage with which the power acts at any point, when the connecting rod is at its minimum length is just *double* what the leverage is at the same point, when the power acts upon the crank in a direction parallel to PD. By a little reflection it will be seen that when the connecting rod is at its minimum length, it remains stationary with its extremity R at D, during half the revolution of the crank. There is, therefore, no power exerted during that time in forcing the crank forward, the power being exerted wholly in the first and fourth quadrants. Inasmuch, however, as the average leverage for the half of the revolution in which it does operate, is just double that for the whole revolution, when the power acts in parrallel lines as demonstrated above, the result is the same in each case. In like manner it may be shown that the result is the same for any length of rod greater than AD.

So far therefore as respects the moving power, nothing is lost in the use of the connecting rod, the result being in all cases in strict ac-

cordance with the principle of *virtual velocities*. *Practically*, however, there are advantages in the use of *a longer* rod. The sliding friction is diminished as the angle at R is lessened, the greater elasticity of a longer rod, is of use perhaps, in overcoming the inequalities of the resistance. In proportion also as the rod is increased in length, the effect of the power is more equably distributed throughout the whole revolution of the crank. It can, however, never become the same in each quadrant, since to accomplish it, the power must act upon the crank at all points parallel with PD—a condition inconsistent with the use of the connecting rod.

TWO REPORTS ON THE COAL LANDS, MINES AND IMPROVEMENTS OF *the Dauphin and Susquehanna coal company, and of the Geological examination, present condition and prospects of the Stony creek coal estate, etc. Pennsylvania; with an appendix containing numerous tables, and statistical information, and various maps, sections and diagrams, chiefly in illustration of coal and iron. Addressed to the board of directors of the Dauphin and Susquehanna coal company, and to the trustees of the Stony creek coal estate.* By Richard C. Taylor, President of the board of directors.

We have been favored by the politeness of the author, with a copy of this report, comprising 187 pages of letter press, and a number of diagrams. We have seldom read anything of this kind, which has given us so much pleasure and instruction. The object of this report is to unfold the prospects and resources of the above named coal tracts, but contains a vast amount of general information on the coal and iron trade far exceeding what is to be found elsewhere condensed into the same space.

The striking feature in this document, is the scientific accuracy displayed throughout its pages. The basis of the report is a careful geological examination of the tracts and the surrounding country, and the candid and impartial tone of the language strikes as giving great authority to its statements.

The coal of this region is the most southern in this part of Pennsylvania, and consequently the nearest to tide water. It approaches the Susquehanna a few miles from Harrisburgh, and requires but 93 miles carriage to Havre-de-Grace, at the head of tide water on the Susquehanna. A remarkable circumstance in regard to these coal fields, is the gradual and almost imperceptible transition from bituminous to anthracite coal. This, in connection with the occurrence of excellent iron ore, has caused Stony creek to be named as a position for a national foundery.

Of the value of this region, the following among other testimonials, is given in the report.

In a printed circular, by Professor Renwick, dated Columbia College, New York, 1832, the writer observes: "the bituminous coal (of Stony Creek) is yet known principally by its analysis. Should this coal be found to be as abundant as there is every reason to believe, the portion of the lands that contain it, cannot fail to acquire a value beyond all cal-

culation; for it will afford facilities for the manufacture of iron equal to those proposed in the most favourable positions in Great Britain; and would enable that important article to compete with the European, without the aid of any protective duty."

We close with the following extract, but propose at our next opportunity to gleam from this report some items of interest on the coal trade.

ADAPTATION OF STONY CREEK VALLEY AS A SITE FOR A NATIONAL FOUNDERY.

Among the various positions named for the site of a *National Foundery*, that of Stony Creek has recommendations superior to most, perhaps to r" others, that have been mentioned for this purpose. We may recount amor the facilities offered by this location.

I. That of uninterrupted canal transportation for boats carrying fro 60 to 80 tons, to tide water at Havre de Grace; the distance of 80 mil being sufficient to secure this position from any sudden hostile approach an invading enemy.

II. That of continuous canal and railroad transportation up the Su quehanna and its tributaries and intersecting lines of communication to the north, and the east, and the west; from the Ohio to the Hudson; from the Chesapeake and Delaware to the Lake frontier.

III. That of ready access to the seat of government.

IV. Its immediate location in the midst of that description of coal which is declared to be the best adapted to the objects required; which coal is divisible into the following modifications, viz:

1. The soft blazing coal of Short mountain, capabable of ng coked.

2. The bituminous and somewhat harder coal of Rattling Rum.

3. The four varieties of still more compact bituminous coal of Yellow Springs.

4. The intermediate or transition coal, consisting of eight or more veins at Rausch Gap, all in some respects varying from each other.

5. The free burning anthracite, approaching to coke, or more highly carbonized coal of Gold-mine Gap, Mount Eagle, and Black Spring Gap; fourteen veins, all having perceptible differences in quality and structure.

V. Its facilities for obtaining several varieties of iron ore, as follows:

1. The brown, red, and black hæmatites, from near Columbia, by Pennsylvania canal, 40 miles to the south.

2. The calcareous red oxide of iron from Danville, 60 miles, and from Bloomsburg, 71 miles to the north, by Pennsylvania canal; also

3. The argillaceous carbonate of iron in seams, accompanying the coal veins here.

4. The excellent bog ore, hydrate of iron, also in the coal region of Stony Creek.

5. The red siliceous iron ore of Short mountain.

VI. The water power of Stony Creek, for which sites present themselves at nearly every half mile for 15 to 20 miles.

VII. The abundance of timber for lumber and for charcoal, extending along nearly the entire length of Stony Creek Valley, and the consequent cheapness of fuel. If for certain purposes, charcoal iron be considered indispensable, the wood of 60,000 acres is attainable.

All other considerations are comparatively unimportant after those enumerated under the seven preceding heads. To these, however, we are enabled to add other desiderata, to which, in the selection of a site for a public

work of this kind, some degree of consequence has elsewhere been attached. These are

VIII. A favourable site for the proving of cannon: and here the slopes of Short and Second mountain present innumerable positions.

IX. Fire clay for bricks, linings, crucibles, &c., required in such a work, abounds in the argillaceous strata of this region. Limestone for flux, eight miles below Stony Creek. Plastic clay, for common bricks, occurs along the valley.

X. Facility of procuring provisions and other necessaries of life; being on the main avenue along which passes the grain, flour, corn, pork, and other agricultural productions of an immense region bordering on the Susquehanna and its tributaries, and even extending far westward beyond the Alleghany mountains. Little need be said about sufficiency of labouring population; because it is a fluctuating body, moving always in the direction of demand and remuneration, and will probably always be equal here to the required amount.

XI. The town of Port Lyon or Dauphin, and the valley of Stony Creek, afford appropriate and healthy sites for the residence of a working population, to almost any imaginable extent.

XII. Low prices of coal and iron are necessarily consequent to the state of things noted in IV. and V. There are several furnaces, forges and rolling mills already established in the vicinity of Stony Creek; from these additional supplies of excellent pig iron can be obtained.

In one or more of the sites most strongly recommended for a national foundery, it is stated that the coal will have to be brought from the mountains by rail-roads and canal, 200 miles, and the iron ore and pig iron 70, and 120 miles. *Here* both these ingredients, possessing every gradation of quality, exist upon the spot.

THE AMERICAN REPERTORY OF ARTS, SCIENCES AND MANUFACTURES.

Edited by James J. Mapes.

We have received Nos. 1 to 5, of this work, which has lately made its appearance as a monthly Journal. Judging from the numbers already before the public, the work appears very well both in point of varity of matter, and neatness of execution. It is proposed to increase the interest in this Journal by reporting the transactions of several societies, chiefly however of the Mechanics' Institute. We hope that it will be better rewarded for the great pains bestowed upon it, than the former proprietors of this work were by thier connection with the same Institute. We understand, however, that the difficulties then existing have been done away with; in that event we can reasonably expect a fair encouragement to the American Repertory.

AUTOGENOUS SOLDERING.

A new process bearing this grandiloquent title, is at present exciting much attention both in England and in France. It is the invention of a Mr. Richemont, and consists in part of a blowpipe, attached to a self regulating reservoir of hydrogen gas, and supplied likewise with common air near the get. *No solder is used*, but the beat of the blowpipe is sufficient to cause the fusion of the metal, and the consequence is the absence of any

joint or seam. The expense of the materials as is well known is a trifle; sulphuric acid and zinc, cost but little, and the resulting sulphate of zinc goes a greatway to pay the cost of them.

The advantages of such a mode of uniting metals, are much greater than would at first be imagined. In the case of lead alone, the saving would be immense, for the galvanic action attendant upon the presence of another metal, so highly exalts the action of any slightly corrosive substance, that in various branches of manufacture, leaden vessels are absolutely discarded, or used at a great cost, simply because they involve the presence of solder.

An important use of this invention is to the soldering of the tubes of locommotive boilers,—the perfect control and management of the flame, giving it a great advantage. There can be no patent for the process in this country—the mode of operation is very simple, and we should be pleased to hear that some of our enterprising manufacturers had tried the experiment.

It is but justice to add, that Mr. Spencer the inventor of the electrotype, claims to have used this plan of soldering and to have made it known to his friends long before the date of the French patent.

ERRATA.—In number 12, vol. IV, New Series, page 362, ninth line from bottom, for "wild *grapes* of the Pontoosuc," read "wild *gorges* of the Pontoosuc."

Railroads.— An article is going the rounds, stating the cost of several of our first and most important railroads. Without explanation it may tend to deceive the public, as to the actual cost, at the present time, of a well constructed railway.

The roads named in the list were generally our first essays and lessons in railroad construction, with expensive inclined planes on a part of the roads named, broken stone foundations, &c. They have generally double tracks, where single tracks, with suitable turnouts, would have answered every purpose, in the present state of travel and traffic. And last, though not least, these roads have cost extra rates per mile, by beginning at the wrong end of making a railway, viz. by commencing the work and calling in capital, before the "right of way," or road bed, on which to construct the road, is first obtained on the choice of the several routes on which it is proposed to construct the road, for the selection of the directors, of the best and least expensive line.

The land for the right of way, and damages (!) on the roads named, have varied from $2,000 to $8,000 per mile, and this on lines where the construction of this new class of improvement has generally added greatly to the value of the property of the farming interest. On the Long Island Railroad, and other roads named in the list, the right of way has cost the stockholders, by a premature location and bad management, near $8,000 per mile. On the Utica and Schenectady Railroad (with damages for the turnpike) the right of way cost about $5,000 per mile, as the road was located by law. This item off from the cost of this road, $19,000 per mile as stated, reduces the same to $14,000 per mile.

On lines where railroads do not cross ridges, and there is not heavy rock

blasting and high embankments, the cost at the present time, for a single track, with the flat and T rails may be stated in round numbers, at from $14,000 per mile for the flat, and $20,000 for the T rail.

The item of $40,000 per mile in the list for the Camden and Amboy is calculated to deceive. That road has a double track and the T rail on a large portion of the road. About $400,000 were paid for land and damages; also about $450,000 for steamboats on the Delaware and at this end of the route. These items taken off, this road costs for a *double* track, depot, an expensive manufactory of locomotives, and for repairs, with other fixtures, less than $25,000 per mile. A contract to test the cost of the first five miles of the New York and Albany Railroad, over the worst average of the road, proves that it may be constructed and put in operation for $15,000 per mile. The N. Y. and Erie Railroad calculate on $10,000 per mile; in this estimate they may be disappointed. J. E. B.

INSTITUTION OF CIVIL ENGINEERS.

(Continued from page 29.)

The preceding results show also that errors have crept in by the adoption of the theoretical method of reducing undulatory surfaces to a level. M. de Pambour extends the length of the road as a compensation for the acclivities or for the help afforded by the bank engines, and Dr. Lardner diminishes the time of the trip to that which he assumes would be occupied in performing it on a dead level. If the principles on which these corrections for the acclivities and declivities are made, be correct, other facts than we are at present acquainted with must be taken into account before it can be demonstrated that a given power will convey a given load at some certain increased velocity along any given undulating line. The resistances which enter into the composition of the sum of the forces are ever varying to such an extent, that it may be doubted whether the the theoretical level be not a pure fiction with reference to the practical results of the experiment.

The effective power of a locomotive engine, or the excess of power after overcoming its proper friction and the resistance from the blast, is solely expended in the generation of momentum. This which is the product of the mass and the velocity represents the useful mechanical effort exerted by the steam, and may always be ascertained under all the practical circumstances of railway traffic. The consumption of power as water, in the shape of steam, is a third quality which may be also readily ascertained. The application of which may be made of the above data is comprehended in the following propositions. First, that equal momenta would result at all velocities from an equal amount of power expended in equal times by the same engine, if the forces opposed to progressive motion and to the effective use of steam in the engines were uniform at all velocities. Secondly, the difference between the momenta generated by a unit of power in a given time at various velocities, measures the difference in the sum of the resistances opposed to the power at those velocities. Having ascertained the gross weight of an engine tender and train—their mean velocity—and the expenditure of water as steam during the trip, simple computations will inform us of—

1. The mechanical effect realized by a given power at all velocities.

2. The total increase or decrease of resistance at all velocities.

3. The ratios which the increase or decrease of resistance at different velocities bear to the ratios of these velocities.

Two other results also follow from the above, and which may be termed the commercial results, viz., the amount of gross and useful tractive effect realized by an equal expenditure of power at all velocities. The difference between these is a useless quantity in a practical sense, being the costly waste of power incident to the locomotive functions of the engine and tender over and above the waste arising from the unascertained and ineffective portion of the whole power required for the blast. The reductions and computations necessary for the exhibition and development of these views are contained in two tables. They relate to forty-nine experiments, being those already referred to, and those by Mr. N. Wood, on the Great Western, and London and Birmingham Railway, and some others. One of these tables contains the velocity of the engines, the consumption of water as steam, the loads, the absolute momenta per second; the momenta generated by equal power in equal times, viz., by 1 lb. of water as steam per second; the weights of the gross and useful loads moved by equal powers, viz., by one cubic foot of water as steam, at the velocity of each experiment, with various other elements. The other table contains a summary of the ratios of the velocities and of their squares, brought into juxta-position with the ratios of the power expended to produce equal momenta, equal gross and equal useful effects, by the comparison of pairs of experiments on the engines given in the preceding table. This table also shows the influence of velocity in the expenditure of power to produce equal mechanical and equal commercial effects; and the amount of loss attributable to the increase of resistance at the higher velocities. The author discusses in great detail the various circumstances of these experiments, and the inferences and practical conclusions which may be deduced therefrom: and comes to the conclusion, that the determination of the performance of locomotive engines by the methods here set forth, is as practicable, exact, and demonstrative of the relative powers and dynamic excellence, as to the determination of duty done by pumping engines.

The intensity of the pressure on the opposite side of the piston arising from the blast has been but imperfectly stated. By some, the discharge of the steam has been likened to a jet, and considered continuous. But an attentive observer can appreciate by his ear that an interval exists between the alternate discharges of steam from the two cylinders. That these jets are periodic and not continuous, is also distinctly evidenced by the audible pulsations in the chimney, even at the very highest velocities of an engine, and their duration may be measured at lower speeds. Upon this intermittent action of the blast depend, in a great measure, the resultant pressure against the piston, and the production of a sufficient current of air through the fire, both which effects would be materially changed in intensity by the substitution of a continuous for a periodic current. The precise duration of the jet, or of the time of the steam evacuating the cylinder, can only be determined by direct and careful experiments; bu its period may be ascertained within definite limits; for since a single discharge is completed within the time occupied by the piston in accomplishing a half stroke, and the pauses between the two successive discharges are distinctly perceptible, a single blast cannot occupy the fourth part of the time of the revolution of the crank shaft, and very probably does not exceed the eighth part, or the period of a quarter stroke of the piston. Under no circumstances, then, can the pressure from the blast oppose the piston much longer than during one fourth of the stroke. With an active pressure, then, of 30 lbs. per square inch, the mean resistance from the blast would not be greater than $7\frac{1}{2}$ lbs., and with a pressure of 15 lbs., not

greater than 3¾ lbs. per square inch, against the pistons. The author then proceeds to cite several observations and experiments made by himself, which are confirmatory of the preceding argument respecting the blast, and he was led conclusively to the fact, that ⅛th of the power of the engine experimented upon, at working pressures of 20 lbs. and 15 lbs., was absorbed in blowing the fire; and the escape of the steam from the cylinder was four times swifter than the motion of the piston.

The author lastly treats of the expenditure of power for a given effect by fixed and locomotive non-condensing engines. But few experiments on the expenditure of steam for a given effect by non-condensing stationary engines have been made. The relative consumption of fixed condensing and non-condensing engines have been treated of by the late Mr. Charles Sylvester, of Derby, whose knowledge and accurate theoretical analysis of the subject are shown by the close accordance of his conclusions with the facts established on two engines of these classes at certain working pressures. His conclusion that the relative economy of these engines will be as the quantities of steam consumed, or as 2 to 1.72, at those pressures, is accurately confirmed by the results here recorded. Mr. Sylvester also showed, that by increasing the pressure upon the same non-condensing engine's cylinder and air pump, so as to maintain the steam in it at a uniform pressure per square inch for all loads, the economy of the former would gradually approach and finally equal the latter. The results obtained in the preceding part of the paper furnish numerous comparisons between the locomotives and fixed non-condensing engines, and the consumption of the latter has been used, together with the condensing engine, as the test of the accuracy of the data of resistance assigned to the former by the various analysts. The accurate determination of the expenditure of steam by the same locomotive engine, in which the values of the friction and of the blast pressure were ascertained, admits of the consumption of water as steam for given effects being determined, and thus narrows the grounds of doubt, and establishes more correct data for ascertaining the real resistance opposed to progressive motion on railways. The application of these principles, as borne out by the experiments of the author, and their particular bearing on the experiments which have been the subject of the previous ample and detailed discussion, form the conclusion of Mr. Parke's series of communications on steam boilers and steam engines.

PLAN TO PREVENT THE FALL OF A MINE BUCKET IN CASE OF THE ROPE BREAKING.

Sir,—The year before last, I sent to the exhibition of the Royal Cornwall Polytechnic Society a model of a plan for raising miners, which I had previously submitted to the inspection of several practical men, who had all expressed a very high opinion of its merits. It was not, however, considered worthy the notice of the judges, and passed the exhibition without any observation. I feel every disposition to rely on the correctness of the decision, come to on that occasion; but yet, as in a greater multitude of councillors there may be more wisdom; and as, while I see the life of the miner most awfully shortened by his occupation, and while I have observed on examination of the burial register of a neighboring parish, that 16¼ *per cent. of the deaths of miners during two years have been accidental*, I see no plan as yet at all likely to be carried into effect, to ameliorate their condition. I feel a great desire to have the opinion of some of your very ingenious and scientifically competent correspondents on the subject.

My plan was that a bucket of any convenient dimensions should be provided with projections on each side to run in grooves, firmly fixed on each side of the whole depth of the shaft. In the same manner, I believe, as the corves in some of the coal mines. I proposed to have the back of some of these grooves constructed like ladders, and furnished with strong and well-secured iron staves. To the upper end of each of the vertical projections of the bucket, were to be fixed by moveable joints, one or more strong crooks, acted on by powerful springs, which should continually press them, with great force, towards the staves in the back of the grooves. On the back of each of these crooks was to be fixed a very strong ring connected by chains or ropes to the principal chain or rope used to raise or lower the bucket. As long as the tension of the main rope continued these crooks would incline inwards over the iron roof of the safety bucket; but in case of the rope breaking, and the consequent removal of its restraint, the springs would force the crooks upon the staves, and the buchet remain suspended until another rope was affixed. I will not enter more minutely into a description of my plan, the model of which worked in the most satisfactory manner, and will only beg to ask the opinion of any of your correspondents in the coal districts as to the practicability of its introduction in grooved shafts already constructed, and to solicit any competent opinions on its suitability, or otherwise, to the purpose for which it was suggested.

I very much fear that unless the press take up the subject, very little benefit will result to our deserving, but much suffering mining population from the annual exhibitions of the Polytechnic Society; and I should rejoice to see your influential journal enlisted with that society in its benevolent efforts in behalf of our working classes.

I remain, Sir, very truly yours,

R. Blee, Jun.

Redruth, Dec. 30th, 1839.

TO THE SENATE AND HOUSE OF REPRESENTATIVES OF THE UNITED STATES OF AMERICA, IN CONGRESS ASSEMBLED:—*the memorial of Edmund Pendleton Gaines, Major General in the Army of the United States, commanding the Western Division, respectfully showeth that—*

(Continued from page 21.)

16. *Operations in the final construction of the work.*

Each one of the proposed routes to be placed in charge of a Colonel, who will superintend the construction of the work; and for the prompt and convenient accomplishment of every part of the work, each route will be subdivided into *ten sections*, and each section placed under the immediate superintendence of a Captain, to be assisted by the whole of the subaltern officers, non-commissioned officers, artificers and privates of the company, with as many volunteer artificers and other operatives as will be sufficient to ensure the completion of each section in from four to five years after the location of the work, which may be accomplished in one year. So that when one section of sixty miles in length is completed, the whole work will be quite, or nearly finished;—with the exception of that which is unavoidably located over a mountainous country. The completion of the mountainous sections may be hastened by such increased means, as the exigencies of the service shall demand. The simple process of carrying on such a work, necessarily increases the *means* and *facilities* of its progress and speedy accomplishment. Thousands of our young men ignorant of every operation upon the work will soon become able operatives. To the regular army we should have the power to add every scientific *me-*

chanic, artificer, and able bodied willing laborer, to be employed as *volunteers*, principally within the limits of the States where the sections of the railroads on which they are to be employed, respectively, are located and constructed; so that the services of all may be near their places of residence. We shall thus call into action and usefulness that class of American genius which would otherwise, to a greatextent, languish and fall into the whirlpools of vice or imbecility for want of employment and judicious direction—that genius which is found in the learned professions, in all the walks of fashionable life, in the pursuits of Agriculture, Commerce, and the Mechanic Arts, as well as in the haunts of dissipation and idleness; whose votaries may indeed often too truly say, "we are idle because no man hath given us employment." By these idlers, whose employment would save them from misery and ruin, and render them valuable citizens, and enable them to render their country invulnerable in war, and enrich it in peace,—aided by the enterprising young men which every section of the Republic is capable of affording for the proposed great work, and arming with the irresistible weapons of industry and enterprise, necessary to enable them in obedience to the sublime mandate of Holy Writ: "to replenish the earth, and subdue it," and render it fruitful, that it may multiply the benefits and blessings which it is capable of yielding to man, the proposed work will be speedily accomplished.

17. The hidden wealth which the progress of the work will disclose, added to the vast supplies of materials for construction, for transportion, and for food and raiment for the operatives upon the work and for commerce —supplies, a considerable part of which every year waste away among the interior sections of the Western and Middle States for want of a cheap conveyance to good markets, such as the proposed railroad will afford, will contribute much towards the completion and final profitable employment of the work;—supplies that would every year be augmented by new improvements, and by encouraged industry, until they would far surpass the immediate wants of the great and increasing influx of population, and operatives upon the public works, and frontier; and on the completion of the work, these constantly increasing supplies would be poured into the improved channels of cheap transportation and profitable commerce—gradually swelling the profits of both, as the millions of tributary rills and rivulets expand the mighty river into whose bosom they pour their liquid treasures. It is believed, moreover, that the construction of the proposed railroads through the Southern, Western, and Atlantic States, would not fail to create the means for the speedy completion of all the latteral branches required for every State and seaport, by multiplying among us experienced engineers, and scientific mechanics, with habits of industry and enterprise; giving to all classes of the community profitable employment, calculated to render them independent in their domestic affairs, respectable and happy in peace, and formidable in war—whilst the money expended would be kept in a healthy state of circulation among the farmers, merchants and mechanics of our interior settlements, in place of its being carried off to enrich foreign merchants, or to form every year at home a new bone of contention, between the votaries of the spirit of party—such as go all lengths for party men, regardless of the true interests and honor of the Republic. And when, during a state of war with nations surpassing in naval strength, we find ourselves compelled to abandon the ocean, and be deprived of our foreign commerce—the inevitable consequence of a war with any of the strong powers of Europe without first supplying ourselves with a fleet of steam ships of war, as well as floating batteries and the proposed railroads, —these roads, even while occasionally employed in the transportation of

troops from the central States to the South, will take return cargoes of Southern products, such as sugar, cotton, oranges and lemons, from the Southern to the Middle and Northern States—from whence they will bring return cargoes of the numerous products and manufactured articles of the northern and central States, needed in the South;—an interior commercial intercourse by which the privations of our foreign commerce would be remedied, and many of the evils of war removed, and all others greatly mitigated. Indeed the completion of the proposed rail roadsand floating batteries, your memorialist believes, would soon effectually prevent the recurrence of war, so long as the United States shall see fit to confine their views and national policy to the *magnanimous principle of* DEFENSIVE WAR: as the proposed means of national defence would give a degree of available strength, both physical and moral, that would render the peril of an attack a perpetual source of terror to our evil disposed neighbors; and consequent *moral strength and security* to our beloved country. * *

19. Ancient and modern history is replete with evidences of the wisest of governments having promptly availed themselves of the use of every description of *weapon*, deemed to be most formidable in war; as well as of every kind of *power* applicable to the purposes of rapidly wielding armies and munitions of war, as soon as practicable after their discovery. We need only advert here to some few discoveries, which, trifling as the first and third may seem, were deemed sufficient at the time of their discovery to merit the attention of men and monarchs of profound wisdom and genius.

First. When the commanders of the armies of King David reported to that veteran monarch, that they had sustained heavy losses in their operations against the Philistines, in consequence of their having employed in battle the *bow and arrow;* David promptly gave orders to his commanders, to avail themselves of the discovery of this then formidable weapon, and make themselves and their men acquainted with the use of it—"so as to place them on an equal footing with their enemy." (See the "History of the Bible," page —.)

Second. When in the 14th century an obscure monk of Germany discovered gunpowder, with some of its uses in war, all the other nations of Europe that were blessed with wise rulers hastened to avail themselves of the discovery—a discovery which ere long induced all the civilized world to change their unwieldy weapons of war for fire arms; gradually laying aside their *war-chariots armed with scythes, battering rams*, with their coat of mail, and most of their personal armor.

Third. The use of *wheel carriages* on improved roads added more than twenty-five per cent to the efficiency of an army, by enabling it to march one fourth further in a given time, and by carrying with it a more ample supply of artillery, ammunition and subsistence, prolonging the period of active operations, and occasionally taking the enemy by surprise; as, by the increased celerity of his movements, Napoleon took the enemies of France by surprise in his first campaign into Italy.

Fourth. All civilized nations speedily availed themselves of the discovery of the *magnetic needle*, with the inventions and improvements in *ship building, the use of sails*, &c., &c. Many of the discoveries here alluded to, however, though they contributed to facilitate the movement of troops and munitions of war, excited little or no interest at the time of their discovery, compared with that of the application of steam power to ships and other vessels, and to vehicles of land transportation on railroads. In these last discoveries we may well be allowed to speak in the language of poetry, and say that

Steam power "was almighty in its birth;"

whilst gunpowder, fire arms, wheel carriages, and all former improvements in marine structures, though partially known and in use for centuries past, have exhibited little or nothing beyond their now apparent state of infancy until within the last and present century. Even now, no civilized nation can boast of any discovery or improvement in fire arms, gun carriages, or in naval architecture, in any wise calculated to be of any *peculiar advantage* to any one nation over another nation; whilst these developments of steam, with floating batteries and rail roads, are calculated to render a nation in the position which we occupy, at least ten times more formidable in a *war of self-defence*, than in *an offensive war*, against nations of equal numercial strength, and provided with the means here proposed. All the discoveries above referred to in the science of war have, however, contributed much to ameliorate the condition of nations, and of armies, in their conflicts and controversies; and greatly to lessen the evils of war. The greater the improvement in this awful and sublime science, the less calamitous, and the more humane have been the results of military operations—wherever the contending parties were equally acquainted with the progressive improvements, and had equal, or nearly equal means of profiting by them. If these propositions are correct—and history proves them to be strictly true—where, it may be asked, where must our improvements in the science of war, dependant on steam power, terminate? The wise and the good who have long cherished the prospect of a blessed *millenium*, will readily answer the question. * * *

24. The apprehended *expense* of the proposed work, constitutes the principal objection advanced by any statesman; or by any man of military mind, whose opinions have come to the knowledge of your memorialist. To this objection it may be answered.

First—That the apprehended appropriations to meet the expense, will be no more than eleven millions of dollars a year, for a period of six years—provided the work is done by the Army of the United States as heretofore suggested.

Second—The employment of the Army upon the work will be to the officers and men, and to the youth of every State and district through which the work will extend, *the best of all possible schools* to prepare them for the defence of the country: as the officers and men so employed will have the proud satisfaction of knowing that every day's labor, in this essential work of preparation, will contribute to increase their moral and physical capacities for usefulness and domestic happiness in peace, and for a glorious triumph over the invading foe in war.

Third—In exhibiting the cost of this system of defence, it is gratifying to find that of the $66,000,000, which is the estimated amount required for the seven railroads from the central States to the sea board and northern frontier, with five floating batteries from the Mississippi river at the *Passes*, and below New Orleans, and five others for the defence of the harbor of New York, more than sixty three millions of that sum will be expended for *materials* and *work*, which the interior of the United states will afford.

Fourth—The most costly material required for the work will be *bar iron* for the *rail ways*, and sheeting for the sides and tops of the floating batteries; of this article not less than 500,000,000 lbs. will be needed. This quantity at 4 cents will amount to $20,000,000,—*twenty millions of dollars.*

Fifth—For supplying the whole of the iron, it is proposed to erect at convenient places, near the site of each one of the seven great railroads, a *foundry and rolling mill*, for the manufactory of the iron required, upon

the same principle that *armories* are established by the United States for supplying the army and navy, and the militia with cannon and small arms. By these works ample supplies of the best of iron may be obtained in season to complete the railroads and floating batteries, in the time here suggested.

We shall, in this way, lay open to the individual enterprize of the people of the United States rich mines of wealth, hitherto but little known; and we shall moreover relieve ourselves of the reproach to which we have for many years been subjected—the reproach of sending to Europe and expending there many millions of dollars for iron, whilst most of our States abound with inexhaustible supplies of this valuable metal, equal to any in Europe. * * * * * * *

32. Your memorialist having at different times during the last seventeen years, submitted to the proper authorities of the War Department most of his views contained in the foregoing 30 sections, as will more fully appear from his official reports (which he prays may be called for and taken as a part of this his memorial) he has thus repeatedly appealed to the War Department; but he deeply regrets to say that his appeals have been wholly unavailing. He now respectfully calls on every member of the national Legislature who loves his country and her institutions, to sustain his efforts in preparing for her a system of defence worthy of their Fathers of the Revolution, worthy of the UNION and of the CONSTITUTION which we all stand pledged to support. Your memorialist did not enter the service of his country for the mere selfish enjoyment of the *pomp* and *ephemeral honors of the field of battle*, (though he would not shrink from a comparison of *his services in battle* with those of any other United States commander now living) his anticipated glory and great object have been to employ her means of defence, ample as they must ever be, so effectually as to convince her neighbours that *honesty is the best policy*, and that *defeat must attend their every act of invasion*; and thus to direct *the elements of war to the attainment of "peace on earth, and good will* towards men." With these impressions he deems it to be an act of common justice to himself, his wife, children and friends, that he should solicit the only relief to which a United States General officer, honored as he has long been with one of the highest commands in the army, and whose best efforts are ever due to his country's service can with propriety claim,—he claims to *be the author and inventor of the system of national defence* herein set forth and explained; he therefore prays Congress to confirm his claim by such *act* or *joint resolution* as in their wisdom shall seem just and right. And your memorialist as in duty bound will ever pray.

EDMUND PENDLETON GAINES.

Nashville, Tenn., Dec. 31st, 1839.

REPORT OF THE DIRECTORS OF THE THAMES TUNNEL COMPANY, TO THE GENERAL ASSEMBLY OF PROPRIETORS, *held at the London Tavern, on the 3rd day of March* 1840.

GENTLEMEN:—Your directors, in making their annual report, desire in the first instance, to refer to a passage in their last statement, which held out a prospect of the near termination of the hazardous portion of this important work.

Your directors then stated, "that they had the gratification to meet the proprietors after many years of anxiety and delay, with the most reasonable hope of having but one more annual meeting between the termination of

all the peculiar hazards and difficulties of the undertaking, and such an advance of the works as shall bring them near to the time when their anxious trust will be discharged by the completion of this most arduous enterprise."

Your directors have the satisfaction now to announce the entire realization of the prospect then held out, during the past year. From the first week after the last annual meeting to the present time, they have had the gratification to observe a steady increase in the rate of progress. For the first fifteen weeks after that meeting, the average weekly rate was under two feet per week, whilst, during the last few weeks the average progress has been increased to nine feet on an average weekly. With the increased rate of advance also, the average cost per foot has diminished, and has greatly tended to reduce the high average cost of the work per foot, whilst the excavation was carried on under the deepest part of the River.

Your directors, indeed, are of opinion, that could the plan of operation so elaborately detailed in two Reports, dated 18th of April and 15th of August, 1838, and which they referred to in detail in their last Report, have been adopted, both time and money would have been saved in the construction of the tunnel, an opinion which they have before expressed, and now repeat, in order to guard against the exaggerated notions of the cost of a roadway under a deep navigable river, compared with the ordinary mode of communication.

Their experience would now lead them to say, that whilst the steady and solid execution of this work proves the perfect practicability of Mr. BRUNEL'S plans for constructing roadways under, instead of over navigable rivers, where circumstances render it necessary, no accurate judgment can be formed of the cost of such a work by that of the Thames tunnel, inasmuch as the Engineer has been constrained to follow a plan, the merit of which was solely (on the assumption of the impracticability of the work) that it risked the least portion of the public money, and for which object alone it was imposed upon the Engineer, when the money was advanced in aid of this undertaking.

The total progress during the year has been 245 feet, and the work is now within sixty feet of the wharf wall of Wapping.

Your directors are now negotiating for the purchase of the property on the Wapping shore, in order to commence the footway descent,—so soon as this shall be accomplished, your Directors propose to make arrangements to open and appropriate one Archway of the Tunnel for foot passengers, retaining the remaining one for the purpose of carrying on the Works until their final completion. They have the satisfaction to report, that according to the present plan, and provided the property could be advantageously obtained, the footway descent will be placed about fifty feet nearer the wharf than it was originally proposed, by which arrangement, this distance of tunnelling will be saved, as well as the earlier opening of the tunnel obtained.

Your directors continue to receive from the authorities of the corporation of London, every facility they can give towards the completion of the work.

Your directors now consider the work practically accomplished,—the local difficulties attending the construction of the tunnel are daily yielding to the progress of making; and they desire to congratulate the proprietors, and the public indeed, on the approaching termination of their labors, and of the great and important work entrusted to their care.

They believe it will long endure to do honor to the science and skill of the Engineer, and the spirit and liberality of the country. They are of

opinion that the tunnel fully deserves the description given of it by the Duke of Wellington, who, from the first to the last, has given it his countenance and support. His grace encouraged the continuance of this undertaking at a time when it was deemed impracticable, and when necessarily his authority and the interest he took in the work, was of the highest importance. In 1828, when the works were suspended, his grace described it as "a work important in a commercial as well as a military and political point of view." Your directors would add that not only do they consider this a just character of the undertaking, but that in point of economy and durability it will be found as a means of communication between the banks of the river, capable of being most favorably compared with any of the great metropolitan bridges.

Statements of the receipts and expenditure of the company, for the year which ended on the 31st of December, 1839, with a general balance sheet, have been prepared, and are now submitted by the directors for the information of the proprietors.

B. HAWES, *Chairman.*

Thames Tunnel Office, Walbrook buildings, Walbrook, 3d March, 1840.

ON A SIMPLE MODE OF OBTAINING FROM A COMMON ARGAND OIL LAMP, A GREATLY INCREASED QUANTITY OF LIGHT: IN A LETTER FROM Sir. J. Herschel, Bart.

GENTLEMEN.—The following simple, easy, and unexpensive mode of greatly increasing the quantity of light yielded by a common argand burner has been used by me for some years, and is adapted to the lamp by which I write, to my greatly increased comfort. It consists in merely elevating the glass chimney so much above the usual level at which it stands in the burners in ordinary use that its *lower* edge shall clear the *upper* edge of the circular wick by a space equal to about the fourth part of the exterior diameter of the wick itself. This may be done to any lamp of the kind, at a cost of about sixpence, by merely adapting to the frame which supports the chimney four pretty stiff steel wires, bent in such a manner as to form four long upright hooks, in which the lower end of the chimney rests; or, still better, if the lamp be so originally constructed as to sustain the chimney at the required elavations without such addition, by thin laminæ of brass or iron, having their planes directed to the axis of the wick.

The proper elevation is best determined by trial; and as the limits within which it is confined are very narrow, it would be best secured by a screw motion applied to the socket on which the laminæ above mentioned are fixed, by which they and the chimney may be elevated or depressed at pleasure, without at the same time raising or lowering the wick. Approximately it may be done in an instant, and the experiment is not a little striking and instructive. Take a common argand lamp, and alternately raise and depress the chimney vertically from the level where it usually rests, to about as far above the wick, with a moderately quick but steady motion. It will be immediately perceived that a vast difference in the amount of light subsists in the different positions of the chimney, but that a very marked and sudden *maximum* occurs at, or near, the elevation designated in the commencement of this letter: so marked indeed as almost to have the effect of a flash if the motion be quick, or a sudden blaze as if the wick-screw had been raised a turn. The flame contracts somewhat in diameter, lengthens, ceases to give off smoke, and attains a dazzling intensity.

With this great increase of light there is certainly not a correspondingly increased consumption of oil. At least the servant who trims my lamp, reports that a lamp so fitted consumes very little if any more oil than one exactly similar on the common plan.

MR. SMEE'S NEW CHEMICO-MECHANICAL GALVANIC BATTERY.

The *London and Edinburgh Philosophical Magazine*, for this month contains a remarkably interesting paper by Alfred Smee, Esq., on the "Galvanic properties of the principal elementary bodies," with a description of a new battery invented by Mr. Smee, and called by him the "Chemico-Mechanical," which for all those *working* purposes on which the minds of men are now so intent, seems greatly to surpass every preceeding invention of the kind. The superior efficiency of this battery depends chiefly on two properties of metalic bodies first brought to light by the experimental investigations of Mr. Smee, (more fully at all events than they ever were before), namely, 1. That the galvanic energy of metallic surfaces, is in proportion to the number of points on such surfaces; and, 2. That platinum, which has long ranked at the head of the galvanic metals, may be precipitated in powder, on the surfaces of other and cheaper metals, so as to make them equal for galvanic purposes to platinum itself in its most comminuted state, such as spungy platinum, which consists of almost an infinity of points. The battery is thus described by Mr. Smee:—

"The battery which I now propose is to be made of either copper plated with silver, silver, palladium, or platinum. The silver can be rolled to any thinness, and therefore is not expensive. Each piece of metal is to be placed in water, to which a little dillute sulphuric acid and nitro-muriate of platinum is to be added. A simple current is then to be formed by zinc placed in a porous tube with dilute acid; when after the lapse of a short time, the metal will be coated with a fine black powder of metallic platinum. The trouble of this operation is most trifling; only requiring a little time after the arrangement of the apparatus, which takes even less than the description. The cost I find to be about 6*d.* a plate of 4 inches each way, or 32 square inches of surface. This finely divided platinum does not adhere firmly to very smooth metals, but when they are rough is very lasting, and sticks so closely that it cannot be rubbed off. On this account, when either silver is employed, or copper coated with silver, the surface is to be made rough by brushing it over with a little strong nitric acid, which gives it instantly a frosted appearance, and this, after being washed, is ready for the platinizing process.

"With regard to the arrangement of the metal thus prepared great diversity exists; it may be arranged in the same way as an ordinary Wollaston's battery with advantage; a battery thus constructed possessing greater power than Profesor Daniell's battery: four cells, containing 48 square inches, in each cell, decomposed 7 cubic inches of mixed gas per five minutes, whilst four cells of Professor Daniell's, in which 65 square inches of copper were exposed in each cell, gave off only five cubic inches in the same time. However, in my battery thus arranged, the action dropped to five cubic inches in five minutes, but it resumed its power after the contact had been broken for a few seconds. This battery also possesses great heating powers, raising the temperature of a platinum or steel wire, one foot long, and of a thickness similar to that used for ordinary birdcages, to a heat that could not be borne by the finger.* Its magnetic power is not less astonishing,

* A small pot battery of six cells fairly fused into globules, two inches of iron wire, and the combustion of different metals was extremely brilliant, when the battery was in com-

three cells supporting the keeper of a magnet through forty-five, two cells through thirty-two, and one cell through twenty thicknesses of paper. An electro-magnetic engine was made to rotate with great velocity, the combustion of the mercury at the breaking of contact, being exceedingly brilliant.

"A battery of this construction should be in every laboratory to be used in most cases where a battery is wanted, and the slight labor attending its operation is scarce worth mentioning. I have used one for 48 hours consecutively without the slightest alteration either of the fluid, or in the arrangement of the metals, and the diminution attending its operation appeared to arise from deficiency of acid, for it *was instantly restored* by a little strong sulphuric acid in each cell. Where the battery is required to possess the same power for a long period, it might be advisable to separate the metals by a porous earthenware vessel, or what answers the purpose equally well, by a thick paper bag, the joinings of which must be effected by shell-lac dissolved in alcohol. By these means the sulphate of zinc is retained on the zinc side of the battery. The use of porous tubes, however, appears from observation, as far as my battery is concerned, *to be nearly superfluous*, at any rate in most cases; for I find that after a battery arranged as Wollaston's had been at work in the same fluid *for forty-eight hours*, it had no zinc deposited on the silver. It is worth remarking, that during the last 24 hours contact had not been broken for a single instant. Notwithstanding these experiments, however, it may be as well in an extensive battery to use porous plates.

"The battery may be arranged like the pot batteries, but I should greatly prefer the troughs, such as used for Wollaston's batteries, from the convenience of packing, and from a battery of the same surface requiring so small a space. A battery may be constructed to form a most powerful calorimotor. It may also be arranged as a circular disc battery. Or it may be made as a Cruickshank's each cell being divided or not by a flat porous diaphragm. Whatever arrangement is adopted, the closer the zinc is brought to the platinized metal, the greater will be the power.

"The generating fluid which is to be employed is water, with one-eighth of sulphuric acid by measure; and the zinc ought always to be amalgamated in the first instance, as that process will be found very economical from its stopping all local action, and the amalgamation will be found not to require repeating, because there is no fear of copper being thrown down on the zinc, which occasionally happens in the sulphate of copper batteries.

"The battery thus constructed is the cheapest and least troublesome in action that has ever been proposed, and from the smallness of its bulk will be found very valuable to electro-magneticians."

Mr. Smee adds:—

"This battery may remain in the acid for any length of time, and neither the amalgamated zinc nor platinized silver will undergo the slightest change, and the whole will be as silent as death. Let only communication be made, the liquid in each cell becomes troubled; it boils—it bubbles, and produces the effects which have been detailed."

ON THE CAOUTCHOUC MANUFACTURE, BY Andrew Ure, M. D., F. R. S., &c. &c.

This department of operative industry has, within a few years, acquired an importance equal to some of the older arts, and promises, ere long, to

bination with a Bachoffner's apparatus. A small piece of silver platinized (two inches each way) with a fold of zinc, was connected with a large temporary horseshoe magnet, when it supported upwards of three hundred weght.

rival even the ancient textile fabrics in the variety of its designs and applications. The manufacture of caoutchouc has, at present, three principal branches—1. The condensation of the crude lumps or shreds of caoutchouc, as imported from South America, India, &c., into compact homogeneous blocks, and the cutting of these blocks into cakes or sheets for the stationer, surgeon, shoemaker, &c. 2. The filature of either the Indian rubber bottles, or the artificial sheet caoutchouc, into tapes and threads of any requisite length and fineness, which, being clothed with silk, cotton. linen, or woollen yarns, form the basis of elastic tissues of every kind. 3. The conversion of the refuse cuttings and coarser qualities of caoutchouc into a viscid varnish, which, being applied between two surfaces of cloth, constitute the well known double fabrics, impervious to water and air.

I. The caoutchouc, as imported in skinny shreds, fibrous balls, twisted concretions, cheese like cakes, and irregular masses, is, more or less, impure, and sometimes fraudulently interstratified with earthy matter. It is cleansed by being cut into small pieces, and washed in warm water. It is now dried on iron trays, heated with steam, while being carefully stirred about to separate any remaining dirt, and is then passed through, between a pair of iron rolls, under a stream of water, whereby it gets a second washing, and becomes, at the same time, equalised, by the separate pieces being blended together. The shreds and cuttings thus laminated, if still foul or heterogeneous, are thrown back into a kind of hopper over the rolls, set one-sixteenth of an inch apart, and passed several times through between them. The above method of preparation is that practised by Messrs. Keene & Co., of Lambeth, in their excellent manufactory, under a patent granted in October, 1836, to Christopher Nickels, a partner in the firm.

In the great establishment of the Joint Stock Caoutchouc Company, at Tottenham, under the direction of Mr. Sievier, a gentleman distinguished no less by his genius and taste as a sculptor, than by his constructive talents, the preparatory rinsing and lamination are superseded by a process of washing practised in Mr. Nickels' second operation, commonly called the *grinding*, or, as it should more properly be styled, the *kneading*. The mill employed for agglutinating or incorporating the separate fragments and shreds of caoutchouc into a homogeneous elastic ball, is a cylindrical box or drum of cast iron, eight or nine inches in diameter, set on edge, and traversed in the line of its horizontal axis (also eight or nine inches long) by a shaft of wrought iron, furnished with three rows of projecting bars, or kneading arms, placed at angles of 120 deg. to each other. These act by rotation against five chisel-shaped teeth, which stand obliquely up from the front part of the bottom of the drum. The drum itself consists of two semi-cylinders; the under of which is made fast to a strong iron framing, and the upper is hinged to the under one behind, but bolted to it before, so as to form a cover or lid, which may be opened or laid back at pleasure, in order to examine the caoutchouc from time to time, and take it out when fully kneaded. In the centre of the lid a funnel is made fast, by which the cuttings and shreds of the Indian rubber are introduced, and a stream of water is made to trickle in, for washing away the foul matter often imbedded in it. The power required to turn the axis of one of these mills, as the drums or boxes are called, may be judged of from the fact, that if it be only two inches in diameter, it is readily twisted asunder, and requires to be three inches to withstand every strain produced by the fixed teeth holding the caoutchouc against the revolving arms. Five pounds constitute a charge of the material.

One of the most remarkable phenomena of the kneading operation, is the prodigious heat disengaged in the alternate condensation and expansion of the caoutchouc. Though the water be cold as it trickles in, it soon becomes boiling hot, and emits copious vapors. When no water is admitted, the temperature rises much higher, so that the elastic lump, though a bad conductor of heat, cannot be safely touched with the hand. As we shall presently find that caoutchouc suffers no considerable or permanent diminution of its volume by the greatest pressure which can be applied, we must ascribe the heat evolved in the kneading process to the violent intestine movements excited throughout all the particles of the elastic mass.

During the steaming, much muddy water runs off through apertures in the bottom of the drum. In the course of half an hour's trituration, the various pieces become aglutinated into a soft, elastic, ovoid ball, of a reddish brown color. This ball is now transferred into another similar iron drum, where it is exposed to the pricking and kneading action of three sets of chisel points, five in each set, that project from the revolving shaft at angles of 120 deg. to each other, and which encounter the resistance occasioned by five stationary chisel teeth, standing obliquely upwards from the bottom of the drum. Here the caoutchouc is kneaded dry along with a little quicklime. It soon gets very hot, discharges in steam through the punctures, the water and air which it had imbibed in the preceding washing operation, becomes, in consequence, more compact, and, in about an hour, assumes the dark brown colour of stationers' rubber. During all this time frequent explosions take place, from the expansion and sudden extrication of the imprisoned air and steam.

From the second set of drums the ball is transferred into a third set, whose revolving shaft, being furnished with both flat pressing bars, parallel, and sharp chisels, perpendicular to it, exercises the twofold operation of pricking and kneading the mass, so as to condense the caoutchouc into a homogeneous solid. Seven of these finished balls, weighing, as above stated, five pounds each, are then introduced into a much larger iron drum of similar construction, but of much greater strength, whose shaft is studded all round with a formidable array of blunt chisels. Here the separate balls become perfectly incorporated into one mass, free from honeycomb-cells or pores, and therefore fit for being squeezed into a rectangular or cylindrical form in a suitable cast iron mould, by the action of a screw press. When condensed to the utmost in this box, the lid is secured in its place by screw bolts, and the mould is set aside for several days. It is a curious fact that Mr. Sievier, has tried to give this moulding force, by the hydraulic press, without effect, as the cake of caoutchouc, after being so condensed, resiles much more considerably than after the compressing action of the screw. The cake form generally preferred for the recomposed, ground, or milled caoutchouc, is a rectangular mass, about 18 inches long, 9 inches broad, and 5 inches thick.

This is sliced into cakes for the stationer, and into sheets for making tapes and threads of caoutchouc, by an ingenious self-acting machine, in which a straight steel blade, with its edge slanting downwards, is made to vibrate most rapidly to and fro in a horizontal plane; while the cake of caoutchouc, clamped or embraced at each side between two strong iron bars, is slowly advanced against the blade by screw work, like that of the slide rest of a lathe. In cutting caoutchouc by knives of every form, it is essential that either the blade or the incision be constantly moistened with water; for otherwise the tool would immediately stick fast. Since the above straight vibrating knife slants obliquely downwards, the sheet which it cuts off

spontaneously turns up over the blade in proportion as it is detached from the bottom mass of the cake. The thicker slices are afterwards cut by hand, with a wetted knife, into small parallelopipeds, for the stationer, the sections being guided rectangularly by saw lines in a wooden frame. The wholesale price of these is now reduced to 2s. per pound. Slices may be cut off to almost any desired degree of thinness, by means of an adjusting screw mechanism, that acts against a board which supports the bottom of the cake, and raises it by an alliquot part of an inch, the cutting blade being caused to vibrate always in the same horizontal plane. These thin slices constitute what is called sheet caoutchouc, and they serve perfectly for making tubes for pneumatic apparatus, and sheaths of every kind; since, if their two edges be cut obliquely with clean scissors, they may be made to coalesce, by great pressure, so intimately, that the line of junction cannot be discovered either by the eye, or by inflation of a bag or tube thus formed.

The mode of recomposing the cuttings, shreds, and coarse lumps of caoutchouc into a homogeneous elastic cake, specified by Mr. Nickels, for his patent, sealed October 24, 1836, is not essentially different from that above described. The cylinders of his mill are more capacious, are open at the sides like a cage, and do not require the washing apparatus, as the caoutchouc has been cleansed by previous lamination and rinsing. He completes the kneading operation, in this open cylinder, within the space of about two hours, and afterwards squeezes the large ball so formed into the cheese form, in a mould subjected to the action of a hydraulic press. As he succeeds perfectly in making compact cakes in this way, his caoutchouc must differ somewhat in his physical constitution from that recomposed by Mr. Sievier's process. He uses a press of the power of 70 tons; such pressure, however, must not be applied suddenly, but progressively, at intervals of two or three minutes between each stroke; and when the pressing is complete, he suffers the caoutchouc to remain under pressure till it is cold, when he thrusts it out of the mould entirely, or, placing his mould in the slide-rest mechanism, he gradually raises the caoutchouc out of it, while the vibrating knife cuts it into slices in the manner already described. The elegant machine by which these sheets are now so easily and accurately sliced, was, I believe, originally contrived and constructed by Mr. Beale, engineer, Church-lane, Whitechapel.

II. *Filature of Caoutchouc for making Elastic Fabrics.*—Messrs. Rattier and Guibal mounted in their factory at St. Denys, so long ago as the year 1826 or 1827, a machine for cutting a disc of caoutchouc into a continuous fillet spirally, from its circumference towards its centre. This flat disc was made by pressing the bottom part of a bottle of Indian rubber in an iron mould. I have described this machine under the article ELASTIC BANDS, in my Direction of Arts, &c. A machine on the same principle was made the subject of a patent by Mr. Joshua Proctor, Westhead, of Manchester, in Feb. 16, 1836; and, being constructed with the well-known precision of Manchester workmanship, it has been found to act perfectly well in cutting a disc of caoutchouc, from the circumference towards the centre spirally, into one continuous length of tape. For the service of this machine, the bottom of a bottle of Indian rubber of good quality being selected, is cut off and flattened by heat and pressure into a nearly round cake of uniform thickness. This cake is made fast at its centre by a screw nut and washer to the end of a horizontal shaft, which may be made to revolve with any desired velocity by means of appropriate pulleys and bands, at the same time that the edge of the disc of caoutchouc is

acted on by a circular knife of cast steel, made to revolve 3000 times per minute, in a plane at right angles to that of the disc, and to advance upon its axis progressively, so as to pare off a continuous uniform tape or fillet from the circumference of the cake. During this cutting operation, the knife and caoutchouc are kept constantly moist with a slender stream of water. A succession of threads of any desired fineness are afterwards cut out of this fillet, by drawing it in a moist state through a guide slit, against the sharp edge of a revolting steel disc. This operation is dexteriously performed by the hands of young girls. MM. Rattier and Guibal employed, at the above mentioned period, a mechanism consisting of a series of circular steel knives, fixed parallel to each other at minute distances, regulated by interposed washers upon a revolving shaft; which series of knives acted against another similar series, placed upon a parallel adjoining shaft, with the effect of cutting the tape throughout its length into eight or more threads at once. An improved modification of that apparatus is described and figured in the specification of Mr. Nickel's patent of October, 1836. He employs it for cutting into threads the tapes made from the recomposed caoutchouc.

The body of the bottle of Indian rubber, and in general any hollow cylinder of caoutchouc, is cut into tapes by being first forced upon a mandril of soft wood of such dimensions as to keep it equally distended. This mandril is then secured to the shaft of a lathe, which has one end formed into a fine-threaded screw, that works into a fixed nut, so as to traverse from right to left by its rotation. A circular disc of steel, kept moist, revolves upon a shaft parallel to the preceding, at such a distance from it as to cut through the caoutchouc, so that, by the traverse movement of the mandril shaft, the hollow cylinder is cut spirally into the continuous fillet of a breadth equal to the thickness of the side of the cylinder. Mr. Nickels has described two methods of forming hollow cylinders of recomposed caoutchouc for the purpose of being cut into fillets by such a machine.

It is probable that the threads formed from the best Indian rubber bottles, as imported from Para, are considerably stronger than those made from recomposed caoutchouc, and therefore much better adapted for making Mr. Sievier's beautiful patent elastic cordage. When, however, the kneading operation has been skilfully performed, I find that the threads of the *ground* caoutchouc, as it is incorrectly called by the workmen, answers well for the every ordinary purpose of elastic fabrics, and are of course, greatly more economical, from the much lower price of the raw material.

Threads of caoutchouc are readily pierced by paring the broken ends obliquely with scissors, and then pressing them together with clean fingers, taking care to admit no grease or moisture within the junction line. These threads must be deprived of their elasticity before they can be made subservient to any torsile or textile manufacture. Each thread is *inelasticated* individually in the act of reeling, by the tender boy or girl possessing it between his moist thumb and finger, so as to stretch it at least eight times its natural length, while it is drawn rapidly through between them by the rotation of the power-driven reel. This extension is accompanied with condensation of the caoutchouc, as shown in my former paper (see the Journal for last month,) and with very considerable disengagement of heat, as pointed out in Nicholsons Journal, upwards of 30 years ago, by Mr. Gough, the blind philosopher of Kendal. I attempted to stretch the thread, in the act of reeling, but found the sensation of heat too painful for my unseasoned fingers. The reels, after being completely filled

with the the thread, are laid aside for some days, more or fewer, according to the quality of caoutchouc, the recomposed requiring a longer period than the bottle material. While thus rendered inelastic, it is wound off upon bobbins of various sizes, adapted to various sizes of brading, or other machines, where it is to be clothed with cotton or other yarn.

The thread of the Joint Stock Caoutchouc Company is numbered from 1 to 8. No. 1 is the finest, and has about 5000 yards in a pound weight; No. 4 has 2000 in a pound weight; and No. 8, 700, being a very powerful thread. The finest is used for the finer elastic tissues, as for ladies' silver and gold elastic bracelets and bands. The ropes made by Mr. Sievier with the strongest of the above threads, clothed with hemp, and worked in his gigantic braiding machine, possess, after they are re-elasticated by heat, an extraordinary strength and elasticity, and, from the nearly rectilinear direction of all the strands, can stand, it is said, double the strain of the best patent cordage of all diameter.

In treating of the manufacture of elastic fabrics, I have great pleasure in adverting to the ribbon looms at Holloway, which display to great advantage the mechanical genius of the patentee, Mr. Sievier. Their productive powers may be inferred from the following statement:—5000 yards of one inch braces are woven weekly in one 18 ribbon loom, whereby the female operative, who has nothing to do but to watch its automatic movements, earns 10s. a week; 3000 yards of two inch braces are woven upon a similar loom in the same time. But one of Mr. Sievier's most curious patent inventions, is that of producing, by the shrinking of the caoutchouc threads in the foundation or warp of the stuff, the appearance of raised figures, closely resembling coach lace, in the weft. Thus, by a simple physical operation, there is produced, at an expense of one penny, an effect which could not be effected by mechanical means for less than one shilling.

III. *Of the Water-proof Double Fabrics.*—The parings, the waste of the kneading operations above described, and the coarsest qualities of imported caoutchouc, such as the inelastic lumps from Para, are worked up into varnish, wherewith two surfaces of cloth are cemented, so as to form a compound fabric, impervious to air and water. The caoutchouc is dissolved either in petroleum (coal tar) naphtha, or oil of turpentine, by being triturated with either of the solvents in a close cast iron pot, with a stirring apparatus, moved by mechanical power. The heat generated during the attrition of the caoutchouc, is sufficient to favor the solution, without the application of fuel in any way. These triturating pots have been called pug mills by the workmen, because they are furnished with obliquely pressing and revolving arms, but in other respects they differ in construction. They are four feet in diameter and depth, receive 13 cwt. at a time, have a vertical revolving shaft of wrought iron four inches in diameter, and make one turn in a second. Three days are required to complete the solution of one charge of the varnish materials. The proportion of the solvent oils varies with the object in view, being always much less in weight than the caoutchouc.

When the varnish is to be applied to very nice purposes, as bookbinding, &c., it must be rubbed into a homogenous smooth paste, by putting it in a hopper, and letting it fall between a couple of parallel iron rolls, set almost in contact.

The wooden framework of the gallery in which the waterproof cloth is manufactured, should be at least 50 yards long, to give ample room for extending, airing, and drying the pieces; it should be two yards wide, and

not less than five high. It is formed of upright standards of wood, bound with three or four horizontal rails at the sides and the ends. At the end of the galley, where the varnish is applied, the web which is to be smeared must be wound upon a beam, resembling in size and situation the cloth beam of the weaver's loom. The piece is thence drawn up and stretched in a horizontal direction over a bar, like the breast beam of a loom, whence it is extended in a somewhat slanting direction downwards, and passed over the edge of a horizontal bar. Above this bar, and parallel to it, a steel-armed edge of wood is adjusted, so closely as to leave but a narrow slit for the passage of the varnish and the cloth. This horizontal slit may be widened or narrowed at pleasure by thumb screws, which lower or raise the movable upper board. The caoutchouc paste being plastered thickly with a long spatula of wood upon the down-sloped part of the web, which lies between the present beam and the above described slit; the cloth is then drawn through the slit by means of cords in a horizontal direction along the lowest rails of the galley, whereby it gets uniformly besmeared. As soon as the whole web, consisting of about 40 yards, is thus coated with the viscid varnish, it is extended horizontally upon rollers, in the upper part of the gallery, and left for a day or two to dry. A second and third coat are then applied in succession. Two such webs, or pieces, are next cemented face to face, by passing them, at the instant of their being brought into contact, through between a pair of wooden rollers, care being taken by the operator to prevent the formation of any creases, or twisting of the twofold web. The under of the two pieces being intended for the lining, should be a couple of inches broader than the upper one, to ensure the uniform covering of the latter, which is destined to form the outside of the garment. The double cloth is finally suspended in a well ventilated stove room, till it becomes dry, and nearly free from smell. The parings cut from the broader edges of the under piece, are reserved for cementing the seams of cloaks and other articles of dress. The tape-like shreds of the double cloth are in great request among gardeners, for nailing up the twigs of wall shrubs.

Mr. Walton, of Sowerby-bridge, has recently substituted sheet Indian rubber for leather, in the construction of the fillet cards for the cotton and tow manufactures. The superior elasticity of this article is said to prove advantageous in several respects.—*Jour. Arts & Science.*

TO THE HONORABLE THE MAYOR, ALDERMEN AND COMMONALTY OF THE CITY OF NEW YORK, IN COMMON COUNCIL CONVENED.— *The petition of the New York and Harlem railroad company, respectfully showeth,*

That your petitioners were incorporated by an Act of the legislature of the State of New York, passed April 25th, 1831, and authorised to construct a railroad, with a double track, to the Harlem river, with a branch to the Hudson river, between 124th and 129th streets. That your petitioners under authority of the aforesaid act of incorporation, and of the subsequent acts of the legislature amending and extending the same, have constructed a railroad, with a double track, from the city hall in the city of New York to the Harlem river, and have now employed thereon, for the transportation of persons and property, six locomotive engines, a large number of cars, and one hundred and forty horses. That at the period when your petitioners commenced the construction of their said road, no railroad of any magnitude had been constructed within the United States, and the art of their construction was in its infancy here, and but little developud at that time comparatively in England. That the natural surface and formation of the land over which the railroad of your petitioners was to run, presented ob-

stacles to the enterprise, of a number and magnitude not to be met with in any railroad of the same length. That in overcoming these obstacles, and in contributing, by the experience gained in the construction of this work, to the advancement of that art which has since been of such signal advantage to the country, and in placing said road in full and complete operation, your petitioners have expended upwards of eleven hundred thousand dollars. That no divedend has ever been made upon the capital stock of your petitioners, and no return has yet been received by their stockholders upon this investment of their property. That when the construction of the railroad of your petitioners was projected, it was contemplated by its originators that as early as it could be completed, a road would be constructed, from the Harlem river northwardly, leading to Albany, and intersecting with the road of your petitioners; and thus giving to their road the advantage of an extended track and a large transportation of the productions of the country.

And your petitioners further show, that accordingly the legislature of the State of New York, by an act passed April 17th 1832, incorporated a company by the name and title of the New York and Albany Railroad Company, with authority to construct such a railroad: That under the expectation that the said last mentioned road would be codstructed by said company, and the original project upon which the enterprise of your petitioners was founded, be thus extended and carried out. Your petitioners persevered in the construction of their works nnder the most constant succession of the most perplexing and discouraging circumstances, until they had the high gratification of completing their road to Harlem, and thus performing their engagements with the people: That the New York and Albany Railroad Company thus incorporated to construct the important work to which your petitioners had ever looked for a share of the bnsiness which was to furnish a just remuneration for their capital invested, after ineffectual efforts to fill up their capital stock, and various extensions of their charter by the Legislature, givign them additional time to fill up their stock and to construct their railroad, became convinced by the experience of seven years unsuccessful labor, that they could not command the necessary means to construct said work, or accomplish the great object for which they were incorporated: That from the early part of the year 1838, it was averred by the inhabitants of the counties of Dutchess and Putnam, that if the railroad could be constructed to the northern boundary of the county of Westchester, a distance of about forty-two miles from the termination of the present road of your petitioners, the citizens of said counties would supply the means to construct said road through the said counties of Putnam and Dutchess, a distance of about seventy-three miles, to connect with the Albany and West Stockbridge road. That your petitioners fully believe that such undertaking will be performed by the inhabitants of Putnam and Dutchess counties, and the expectation of their efficient co-operation, induced the New York and Albany railroad company to apply to the legislature for the aid of the State, at the session of 1839, for the purpose of enabling them to construct their said road through the county of Westchester, and thus connect its continuation to the liberal and enterprising people of the counties aforesaid: And your petitioners further show, that apppre hending from the total failure of the New York and Albany railroad company to make but little progress in the construction of their work, for a period of upwards of seven years, that the said company would never be able to complete such work, and viewing its early construction as of vital importance to the commerce, convenience, and interest of the city of New York as well as an object of immediate concern to your petitioners—your petitioners were induced to apply to the legislature of the State of New York, at

the session of 1840, for leave to extend their railroad to the northern boundary of Westchester county, and thus bring this great link in the chain of communication, between the commercial metropolis and the mighty west, within the reach of those who stand ready to complete it.

That before making any application to the legislature for the purpose aforesaid, your petitioners caused a draft to be made of an act authorising and empowering them to construct a railroad with a single or double track, through the county of Westchester, commencing at the Harlem river and extending with one line of road from thence northwardly to an intersection with the New York and Albany railroad company's line of road at such point as might be mutually agreed upon between the two companies, with authority to construct a bridge across the Harlem river to connect the same with the present road of your petitioners, and informed the said New York and Albany railroad company of such design of your petitioners, and submitted to them the draft of the law which your petitioners had so prepared for that purpose. That the said New York and Albany railroad company fully approved of the application so proposed to be made by your petitioners, and of the law as drafted by them; but wished some further stipulations for their benefit, coupled with such assent to reimburse them for all expenses therefore incurred by them in Westchester county, within which the road theretofore proposed to be made by them was to be taken and constructed by your petitioners. And your petitioners further show, that they assented to the said proposition of the New York and Albany railroad company, and thereupon an agreement in writing was duly made and entered into by and between the said companies in relation to said laws, as follows, that is to say,—

New York, Feb. 28, 1840.

The undersigned hereby agree to the amendments as expressed in the subjoined copy of an act amending the New York and Harlem railroad company, about to be submitted to the legislature.

We also agree and mutually bind ourselves to the following stipulations, viz: the New York and Harlem railroad crmpany agree to pay the New York and Albany railroad company all expenses hitherto paid out and incurred by them in Westchester county; payment to be made in the stock of the New York and Harlem railroad company, or in bonds of the company, at three years from the passage of the act in question, on the assumption of the rights that may be granted and the commencement of the work.

(Signed) Chas. Henry Hall,
President of the New York and Albany R. R. Co.
Gouverneur Morris,
V. P. N. Y. & Albany R. R. Co.

Francis Barretto,
Jonathan A. Taber,
Jonathan Akin,
Alpheus Sherman,
John Harris,
} *Directors of the Company*

I hereby concur in the above arrangement.

(Signed) Samuel R. Brooks,
President of the N. Y. & Harlem R. R. Co.

That at a meeting of the board of directors of your petitioners, the said contract entered into by the president of your petitioners on their part, with the New York and Albany railroad company was duly confirmed.

And your petitioners further shew, that in pursuance of said agreement, the law so drafted and assented to by the New York and Albany railroad company was presented to the legislature, and was duly enacted by them on

the 7th of May, 1840.—That a copy of said act is hereunto annexed, marked paper A. That in and by the said act the legislature fully ratified and confirmed the contract made between the said New York and Albany railroad company and your petitioners, and vested in them all the powers contained in the several acts authorising the construction of the New York and Albany railroad; gave to your petitioners the exclusive right of constructing a railroad northwardly through Westchester county.

And your petitioners further show, that under and by virtue of the said last mentioned act of the legislature, your petitioners are about proceeding to locate their railroad to the northwardly boundary of Westchester county, and intend to construct such railroad as soon as the necessary means can be obtained for that purpose. That your petitioners conceive that great and important advantages will flow to the city of New York from the construction of the said railroad, and that the benefits will be more immediate from such being accomplished by your petitioners than would accrue were it to be performed by another Company.

That from the road of your petitions being in full operation, with sufficient engines, cars, and horses, for a more extended action, as soon as one mile of the new road should be constructed, your petitioners could extend the trips of their cars to the point of such completion, while a new Company would be obliged to complete a very considerable part of the road before they could afford to make the necessary outlay for engines and cars, and commence operations upon it.

And your petitioners further show, that the connection of the City of New York with the City of Albany, by means of a railroad, is a subject deeply interesting, not only to the inhabitants of this city, but to the whole Northern and Western country. That during one quarter of the year the Hudson river is closed with ice; and at the most inclement and inactive season communication between the interior and the city is absolutely cut off, or accomplished with so much labor, toil, and danger, as to deter vast numbers from making the attempt. The supplies of the provisions, as well as the means of commercial intercourse, are either suspended or procured at great additional expense. The line of railroad between Albany and Buffalo is now more than two-thirds completed, and the residue in progress of construction under the flattering prospect of presenting a continous line of railroad between those two cities as early as the year 1841. That our enterprising and vigilant neighbors of the city of Boston, are rapidly progressing with their Great Western railroad, designed to reach the capitol of our State; and have recently taken the capital stock of the Albany and West Stockbridge railroad, and engaged in the construction of that work to complete their line of direct communication with the great lakes. The city of Albany, with a zealous regard for the interests of its inhabitants, has freely lent its credit to the extent of six hundred thousand dollars to that enterprise, which is designed to make that city and Boston the great market for disposing of the manufacture of the east, and procuring the supplies from the west. While this enterprise and zeal have been exhibited all around us, giving artificial advantages to places not able to compete with us by the gifts of nature, the inhabitants of this city, and the publicly chosen and constituted guardians of the interests and welfare, have not as yet aided in the construction of this important link in the great chain of intercommunication, or contributed to ensure a free access for all purposes of commerce, business and pleasure to the vast regions with which we trade. That during the long continued period of commercial embarrassment and adversity through which we have been passing, our enterprising and liberal-minded citizens have been unabled to withdraw from their private

business the means of erecting a great public work; and under these circumstances your petitioners are compelled to seek a loan of the public credit, upon the most ample security, and for the most laudible objects and extended benefits. That by a loan of the credit of the city to the extent of three hundred thousand dollars your petitioners will be enabled immediately to undertake and forthwith construct their road through the County of Westchester; and thus, with the aid of the inhabitants of Putnam and Dutchess, soon complete the whole line to Albany. That as a security for such loan, your petitioners have to offer a mortgage constituting the first lien upon their railroad now completed to Harlem, and which, in itself, cost your petitioners the sum of upwards of nine hundred thousand dollars exclusive of the appurtenances to the road, which cost between two and three hundred thousand dollars. That as a public return for this public favor, your petitioners will make, free, rapid and easy access to the rich interior of some of our most populous and wealthy counties, and open the markets of this city to the bountiful and cheap supplies of their productions at all seasons of the year. Your petitioners therefore pray that your honorable body will be pleased to pass an ordinance authorising the issue of the bonds of this city to your petitioners, to the extent of three hundred thousand dollars, the bonds to be payable in twenty years, bearing interest at five per cent., payable semi-annually, upon your petitioners executing a mortgage to the Corporation upon their railroad now constructed, and constituting the first lien or encumbrance thereon; the whole amount of which bonds, or of the proceeds and avails thereof, to be applied solely and exclusively, under the direction of the comptroller, or such officer as your honorable body may be pleased to designate, to the construction of such railroad within the limits of the county of Westchester; or that your honorable body would grant to your petitioners such other or further aid in the premises as in your judgment may best promote the interests of the people.

And your petitioners will ever pray, &c.

[L. S.] SAMUEL R. BROOKS, *President.*

BENJAMIN COX, *Secretary.* *New York, July 11th*, 1840.

The Commercial List of Saturday last, contains the following:—

Locomotive Engines.—Amid the general gloom and stagnation in b usi ness, particularly among the manufacturers, it is gratifying to be able to state that such is the acknowledged superiority of the Locomotive Engines manufactured by our ingenious fellow citizen, WM. NORRIS, that his establishment continues in full operation; upwards of 275 hands being employed in it at the present time. Numerous orders have been received by him from the *Old World*, and more are soon expected. Among the orders already executed for Europe, we notice the following; eleven engines have been constructed and received in England for the Birmingham and Gloucester railway, and an order from the Directors, for two additional machines, has just been received by the Great Western.

Five engines have been ordered and despatched to AUSTRIA and a sixth is to be shipped thence in a few days. One locomotive has been completed for a railway in Germany, and seven more have been contracted for. In addition to the above establishment, we have the extensive establishments of Messrs. Baldwin, Vail & Hufty, and Eastwick & Harrison in this city, whose machines are of the first order.

In the number and variety and extent of her manufacturing establishments, Philadelphia stands proudly conspicuous among her sister cities, and wfth a return of better times, the number will be materially increased.